Hisayoshi NOZAKI*: **Zygote germination in *Eudorina elegans* var. *synoica* (Chlorophyta, Volvocales)**

野崎久義*: 緑藻 *Eudorina elegans* var. *synoica* (オオヒゲマワリ目) の接合子の発芽

(Pl. VIII)

Eudorina elegans Ehr., a colonial green flagellate, is classified into one dioecious and two monoecious varieties (Goldstein 1964). The morphological details of zygote germination in this species, however, have been observed in only a heterothallic and dioecious variety, *E. elegans* var. *elegans* (Schreiber 1925, Goldstein 1964, Nozaki 1983a). This study was undertaken to elucidate the process of zygote germination of a monoecious variety, *E. elegans* var. *synoica* Goldstein.

Material and methods Soil samples from which *E. elegans* var. *synoica* was isolated were collected in a paddy field at Miho-cho, Midori-ku, Yokohama-shi, Kanagawa Prefecture in January 1980. Clones were established by the pipette-washing method (Pringsheim 1946) from Petri dishes in which a small amount (ca 0.5 g) of the dried soil sample had been rewetted with distilled water. The methods of culture are the same as those described in a previous paper (Nozaki 1983a). The general morphology and reproduction of these materials are described elsewhere (Nozaki 1985).

Sexual colonies developed spontaneously under the usual culture conditions (Pl. VIII, A), several days after inoculating vegetative colonies into the fresh growth medium. Aplanozygotes were subsequently formed by conjugation between male and female gametes within the sexual colonies. The zygotes turned reddish brown in colour after about one week. These mature zygotes were pipetted into the growth medium solidified with 0.6% agar in Petri dishes. These cultures were kept in darkness for about one month, after which the zygotes were transferred to the liquid medium and grown under the illuminated conditions.

Obsevations The zygotes began to germinate within a day after they were

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transferred to the liquid medium under the usual illumination. Initially part of the outer wall ruptured. The inner wall in this region then protruded and swelled, forming an ellipsoidal shape (Pl. VIII, B, D).

Meanwhile, the protoplast within the zygote frequently underwent a transverse division (Pl. VIII, E). As a result, two approximately equal-sized protoplasts were formed in the zygote wall (Pl. VIII, E). Subsequently, the two protoplasts gradually squeezed out into the protruding wall, grew two equal flagella and separated from each other within the expanding wall (Pl. VIII, F, G). A hyaline body, probably a meiotic product, could be observed (arrow head, Pl. VIII, F, G). The tip of the wall then ruptured and the two biflagellate gone cells were released separately, leaving the empty zygote wall behind (Pl. VIII, H, I). Each of these two gone cells had the potentiality to develop into a gone colony.

However, relatively small zygotes occasionally did not undergo a transverse division when they germinated. In the germinating, ellipsoidal zygote, a small hyaline body budded off from the protoplast within the protrudent wall (arrow head, Pl. VIII, B, C). The protoplast then grew two equal flagella as it squeezed out into the protruding wall (Pl. VIII, C). The tip of this wall subsequently ruptured and a single biflagellate gone cell moved out, leaving its empty wall behind.

Irrespectively of these two types of zygote germination, the liberated gone cells had the same form and developed into gone colonies in the same way as described in *E. elegans* var. *elegans* (Nozaki 1983a). The gone cell was nearly spherical in shape, 12-18 μm in diameter, and contained reddish brown granules shared from its former zygote. Before cell division, the cell secreted a gelatinous envelope from which the two flagella projected. It subsequently divided successively to form a gone colony as in asexual reproduction within the gelatinous envelope. During the colony formation, the envelope containing the developing embryo moved by means of the two flagella which were retained intact from the original gone cell.

Discussion Although the germinating zygote of *E. elegans* var. *elegans* gives rise to a single biflagellate gone cell (Schreiber 1925, Goldstein 1964, Nozaki 1983a), that of *E. elegans* var. *synoica* frequently produced two equal biflagellate gone cells (Pl. VIII, D-H). A similar situation has been reported by Waters (1960) using heterothallic and dioecious strains of *E. illinoisensis* (Kofoid) Pascher, in which two viable gone cells are most frequently produced in the germinating zygote. Therefore, the number of viable gone cells from a germinating zygote does not correlate with whether the colonies of *Eudorina* are dioecious or monoecious. However, "two gone cells from a germinating zygote" in *Eudorina* is unique in the Volvocaceae and Astrephomenaceae. A germinating zygote of *Gonium* gives rise to four biflagellate gone cells (Schreiber 1925, Stein 1958, Kusumoto et al. 1978, Saito 1984, Nozaki 1986), while a single gone cell is produced from a germinating zygote in *Pandorina* (Coleman 1959, Rayburn & Starr 1974, Nozaki & Kasaki 1979, Nozaki 1981), *Volvulina* (Nozaki 1982), *Platydorina* (Harris & Starr 1969), *Volvox* (Pocock 1933, 1938, Metzner 1945, Darden 1966, Kochert 1968, Starr 1969, 1970, Vande Berg & Starr 1971) and *Astrephomene* (Brooks 1966, Nozaki 1983b).

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Explanation of Plate VIII

Plate VIII. *Eudorina elegans* Ehr. var. *synoica* Goldstein. B, C, I: Phase contrast. A: Sexual colony having bundles of male gametes (arrows) and female gametes (arrow heads). B, C: Germinating zygotes producing a single gone cell. Arrow head indicates a hyaline body (putative meiotic product). B: Initial stage. C: Late stage. D–H: Germinating zygotes producing two gone cells. Arrow head indicates a hyaline body. D: Initial stage. E: Just after a transverse division. F: Two gone cells squeezing out into the protruding wall. G: Just prior to the liberation of gone cells. H: Two gone cells escaping from the zygote wall (arrows). I: Empty walls and zygotes. Figs. B–I are at same magnification.

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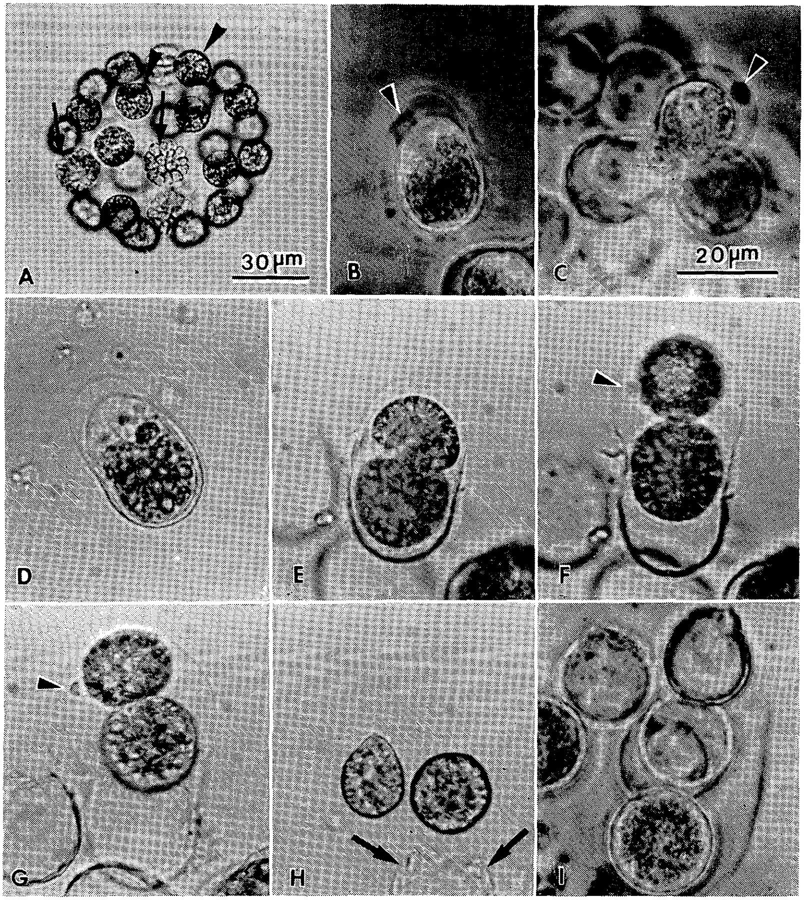
雌雄同体の変種 *Eudorina elegans* Ehr. var. *synoica* Goldstein (緑藻・オオヒゲマワリ目) の接合子の発芽を培養条件下で詳細に光顕観察した。発芽時になると接合子の壁の一部が突出し，膨潤し始める。比較的小さい接合子の場合は1個の等長2鞭毛型の gone cell が壁より遊出することもある。しかし，多くの場合，壁の中で原形質が横に分裂して，等長2鞭毛型のほぼ同大の gone cell を2個形成する。これら2個の gone cell は壁より遊出後，同じように分裂をくりかえして，それぞれ gone colony となる。後者の発芽様式は雌雄異体の承名変種 *E. elegans* var. *elegans* では報告されていないが，Waters (1960) が *E. illinoisensis* (Kofoid) Pascher の雌雄異体の株の接合子で観察している。1個の接合子より2個の gone cell の形成は *Eudorina* を除けば，オオヒゲマワリ科やアストレフォメネ科では知られない発芽様式である。

□Vaucher, Hugues: **Elsevier's dictionary of trees and shrubs, in Latin, English, French, German, Italian** 413 pp. 1986. Elsevier Science Publisher, Amsterdam. ¥30,000. さきに Macura, P. により Elsevier's dictionary of botany I Plant names (1979), II General terms (1982) が出版されているが，本書はその I と似たスタイルのものである。Macura (1979) は植物の英名の下に仏独学名が列記され，別に仏独露学名から英名の見出し番号がたどれる索引がついており，学名にして約6900件が収容されている。一方本書は学名の下に英仏独伊名が列記され，別にこれらの土名別に直接学名を知ることができる索引がついている。収容件数は学名にして約2300である。本書はその内容からみて Macura (1979) と重複した，というより引き継いだ部分が多いはずだが，そのことについては巻末の文献欄に引用されているのみである。収容件数の減少についてはなぜかわからないが，前書は隠花植物も収容しているのに対して本書は温帯の顕花植物を主体としているところに理由のひとつがあるようだ。本書が前書と一番違うところは，植物体の大きさとか常緑落葉の区別，栽植土壌の条件，同類の分布域などのごく簡単なノートがついていて，植栽関係の用途を考慮している点のみである。サイズは Macura (1979) が 15×23 cm，本書が 17×25 cm とわずかに異なっている。同じ書店の同類の出版物としては計画性にとぼしいもので，なぜ前書の拡張を図らなかったのか，もったいないはなしである。イタリア名に執着しなければ，収容数の多い Macura (1979) で十分だろう。　(金井弘夫)



H. NOZAKI: *Eudorina elegans* var. *synoica*